

# **EXHIBIT D**



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## RUSSELL F. DUNN, PH.D., P.E.

### Curriculum Vitae

#### PRIMARY INTERESTS:

- Chemical, environmental and polymer science and engineering
- Computer-aided chemical process and product design, simulation and economic assessment
- Industrial environmental and energy systems process design, analysis and operation
- Pilot Plant design, operation and scale-up to commercialization
- Chemical and polymer product liability and process safety issues
- Environmental forensics investigations involving industrial chemical releases
- Polymeric forensic investigations and failure analysis
- Analytical chemistry and polymer analysis (Microscopy, FTIR, DSC, TGA, GC/MS, GPC)

#### EXPERIENCE:

<b>Polymer and Chemical Technologies, LLC</b>	Pensacola, Florida	2004-Present
President and Founder		
<b>Vanderbilt University</b>	Nashville, Tennessee	2011-Present
Professor of the Practice, Department of Chemical and Biomolecular Engineering		
<b>McSwain Engineering, Inc.</b>	Pensacola, Florida	2001-2004
Chemical Engineering Consultant		
<b>Monsanto Chemical Company/Solutia</b>	Pensacola, Florida	
Science Fellow & Research Team Leader		1999-2001
Senior Research Specialist & Research Team Leader - Nylon Plastics Technology		1998-1999
Research Specialist - Nylon Plastics, Polymer and Industrial Fibers Technology		1995-1998
<b>General Electric Plastics</b>	Mt. Vernon, Indiana	
Technology Specialist - LEXAN Polycarbonate Process Technology		1995
<b>Auburn University</b>	Auburn, Alabama	1990-1995
Chemical Engineering Faculty Member		
<b>Ampex Recording Media Corporation</b>	Opelika, Alabama	
Staff Engineer - Research and Development		1990
Senior Engineer - Research and Development		1987-1990
Solvent Recovery Department Manager		1985-1987
Associate Engineer - Solvent Recovery Department		1985

#### ENGINEERING REGISTRATION:

Registered Professional Engineer in the State of Florida, P.E. #59304                    2003-Present

**ACADEMIC AFFILIATIONS:**

<b>University of West Florida</b>	Pensacola, Florida	2006
Adjunct Professor, Department of Chemistry		
<b>Texas A&amp;M University</b>	College Station, Texas	2003-2005
Industrial Advisory Board		
<b>Auburn University</b>	Auburn, Alabama	1998-2004
Chemical Engineering Alumni Advisory Council		1998
Established the Auburn University/Solutia Industrial Residency Program		1995
Established the Auburn University/General Electric Industrial Residency Program		
<b>Technical University of Denmark</b>	Lingby, Denmark	2000
Guest Professor, PhD Course in Chemical/Manufacturing Engineering		
<b>Carnegie Mellon University</b>	Pittsburgh, Pennsylvania	1997-2001
Industrial Advisory Board Member		
<b>University of South Florida</b>	Tampa, Florida	2001
PhD Advisory Committee		

**EDUCATION:**

<b>Auburn University</b>	Auburn, Alabama
1994	Ph.D. in Chemical Engineering Dr. Mahmoud El-Halwagi - Research Advisor Dissertation: <b>Synthesis of Optimal Heat-Induced and Energy-Induced Separation Networks for Waste Minimization</b>
1988	Master of Chemical Engineering Minor in Management
1984	Bachelor of Chemical Engineering

**HONORS AND AWARDS:**

2015	Outstanding Chemical and Biomolecular Engineering Faculty Award, Vanderbilt University
2003	Nylon Polymer Patent Award
2001	Auburn Alumni Engineering Achievement Award, College of Engineering, Auburn University
2000	Appointed NATO Science Representative to Northern Ireland
1999	Appointed Science Fellow, Solutia
1999	Solutia Corporate 1999 Customer Focus Award, Solutia
1998	Incentive Award for Product Development, Solutia Technology
1994	Outstanding Chemical Engineering Faculty Member Award, Auburn University
1988	Process Design Award, Ampex Corporation
1988	Incentive Award for Excellence in Research and Development, Ampex Corporation
1987	Incentive Award for Excellence in Research and Development, Ampex Corporation
1983	Inducted into Omega Chi Epsilon (Chemical Engineering Honor Society)

**SCIENTIFIC AND PROFESSIONAL SOCIETIES:**

1986-Present	<b>American Institute of Chemical Engineers – Life Member</b> National Director, Environmental Division, 2001-2004 Environmental Division Executive Board, 2001-2004 National Programming Committee, 2001-2004 Technical Advisor, Sustainable Engineering Forum, 2004-2007
1999-Present	<b>American Chemical Society</b>
1999-Present	<b>Society of Plastics Engineers</b>
2003-Present	<b>National Society of Professional Engineers</b>
1991-1995, 2012-Present	<b>American Society for Engineering Education</b>
2006-Present	<b>Auburn Alumni Association – Life Member</b>

**PUBLICATIONS:**

- *Journal of Chemical Technology and Biotechnology*
- *Industrial and Engineering Chemistry Research*
- *Chemical Engineering Science*
- *AICHE Journal*
- *Waste Management*
- *Journal of Hazardous Materials*
- *Engineering Failure Analysis*
- *Journal of the Air and Waste Management Association*
- *Advances in Environmental Research*
- *Clean Products and Processes*
- *Clean Technology and Environmental Policy*
- *Journal of Cleaner Production*
- *Journal of Environmental Science and Health*
- *Process Design Tools for the Environment*
- *Towards Zero Emissions - Book*

**PRESENTATIONS:**

- *NATO Conference on Clean Products and Processes*
- *American Institute of Chemical Engineers Conferences*
- *American Chemical Society Conferences*
- *Copenhagen Waste and Water Conference*
- *United Engineering Foundation Conferences on Clean Products and Processes*
- *Aditya Birla (India) Conference on Process Intensification and Re-engineering*
- *Process Integration Annual Meeting*
- *American Institute of Chemical Engineers - Center for Waste Reduction Technology Conferences*
- *Institute for Operations Research and the Management Sciences Annual Meeting*
- *National Association of Corrosion Engineering Annual Conference*
- *North America Membrane Society Conference*
- *Water Environment Federation Conference*
- *Tennessee Valley Authority Environmental Research Center*
- *Danish Center for Industrial Water Management*
- *Rohm and Haas Company*
- *Owens-Corning Corporation*
- *Science Applications International Corporation*
- *Auburn University*
- *Aalborg University, Denmark*

**PATENTS:**

Non-halogenated Polyamide Composition, B. Lysek, R. F. Dunn, C. Kostakes, U. S. Patent No. 6,562,896, May 13, 2003.

Catholyte Heat Recovery Evaporator and Method of Use, A. Davis, T. Yohe and R. Dunn, Patent No. 8,317,994, Dec. 1, 2012.

Method and Apparatus for Making and Concentrating an Aqueous Caustic Alkali, A. Davis, T. Yohe and R. Dunn, Patent No. 8,986,517, Mar. 24, 2015.

**PUBLICATIONS, PRESENTATIONS AND CONFERENCE ACTIVITIES DETAILS**

**CONFERENCE ORGANIZING COMMITTEES:**

1. Foundations of Computer Aided Process Design 2014: Design for Energy and the Environment, Cle Elum, Washington, 2014.
2. Foundations of Computer Aided Process Design 2009: Design for Energy and the Environment, Breckinridge, Colorado, 2009.
3. AIChE Topical Conference on Pulp and Paper Sustainability Issues, Spring Meeting, Atlanta, Georgia, 2005.
4. AIChE Topical Conference on Process Integration, Spring Meeting, New Orleans, Louisiana, 2004.
5. United Engineering Foundation Conference on Clean Products and Processes-II, Lake Arrowhead, California, November 1999.
6. AIChE Center for Waste Reduction Technologies (CWRT)-Water Management Workshop, St. Louis, Missouri, November 1999.

**NATIONAL MEETINGS CHAIRED:**

1. Green Chemistry and Reaction Engineering, M. Abraham (Chair) and R. F. Dunn (Co-Chair), American Institute of Chemical Engineers 2004 Annual Meeting, Austin, TX, November 2004.
2. Process Design for Sustainability, R. F. Dunn (Chair) and Paul Blowers (Co-Chair), American Institute of Chemical Engineers 2004 Annual Meeting, Austin, TX, November 2004.
3. Sustainable Energy, R. F. Dunn (Chair) and Lori T McDowell (Co-Chair), American Institute of Chemical Engineers 2004 Annual Meeting, Austin, TX, November 2004.
4. Process Integration for the Environment, R. F. Dunn (Chair) and G. Parthasarathy (Co-Chair), American Institute of Chemical Engineers 2002 Annual Meeting, San Francisco, CA, November 2003.
5. Process Integration of Material and Energy, R. Dunn (Chair) and V. Manousiouthakis (Co-Chair), *AIChE 2000 Annual Meeting*, Los Angeles, November 2000.
6. Challenges for Design in Practice, R. Dunn (Chair) and K. Trivedi (Co-Chair), *AIChE 2000 Spring Annual Meeting*, Atlanta, March 2000.
7. Environmental Issues in Design, M. Bagajewicz (Chair) and R. F. Dunn (Co-Chair), *AIChE 2000 Spring Annual Meeting*, Atlanta, March 2000.
8. Cleaner Materials and Products, R. Dunn (Chair) and J. Rodgers (Co-Chair), United Engineering Foundation Conference on Clean Products and Processes-II, Lake Arrowhead, California, November 1999.
9. Managing Environmental Risks, H. Cabezas (Chair) and R. F. Dunn (Co-Chair), *AIChE 1999 Spring Annual Meeting*, Houston, March 1999.
10. Tutorials in Batch Process Design and Operations: *Design*, U. M. Diweker (Chair) and R. F. Dunn (Co-Chair), *AIChE 1998 Spring Meeting*, New Orleans, March 1998.
11. Tutorials in Batch Process Design and Operations: *Scale Up and Operations*, U. M. Diweker (Chair) and R. F. Dunn (Co-Chair), *AIChE 1998 Spring Meeting*, New Orleans, March 1998.
12. Tutorials in Batch Process Design and Operations: *Methods and Tools*, U. M. Diweker (Chair) and R. F. Dunn (Co-Chair), *AIChE 1998 Spring Meeting*, New Orleans, March 1998.

**SHORT COURSES TAUGHT:**

1. Nylon 6,6 Plastics and Polymers: Chemistry and Process Fundamentals, R. F. Dunn et al., *Solutia*, Pensacola, FL, August 2001.
2. Process Integration Technology for CLEANER Production: A Short Course on Energy Conservation and Waste Reduction Process Design, R. F. Dunn, *Pensacola Beach*, August 1999.
3. Process Integration Design Tools for Wastewater Reduction and Water Conservation in the Chemical Process Industries, R. F. Dunn, *Center for Industrial Water Management*, Copenhagen, Denmark, June 1999.
4. Pollution Prevention Through Process Integration, M. M. El-Halwagi and R. F. Dunn, *Pensacola Beach*, Florida, September 1997.
5. An Introduction to Energy Integration Using Pinch Technology and Other Techniques, R. F. Dunn, *Monsanto Chemical Company*, Decatur, Alabama, April 1997.

6. Optimal Design and Assessment of Waste-Management Processes, M. M. El-Halwagi and R. F. Dunn, *Eastman Chemical Company*, Kingsport, Tennessee, November, 1993.

## **PUBLICATIONS AND REPORTS:**

### **Books and Chapters Authored or Edited**

1. Air Pollution Control Technology Handbook, Karl B. Schnell, Russell F. Dunn and Mary Ellen Ternes, Second Edition, CRC Press, 2016, 429pp.
2. Using Process Integration to Retrofit Processes for Energy Conservation and Wastewater Minimization, Russell F. Dunn and Jarrid Scott Ristau, Ch. 6 in Chemical Process Retrofitting and Revamping: Techniques and Applications, in press 2016.
3. Analyzing Complex Chemical and Polymer Manufacturing Plants: A Macroscopic Approach, R. F. Dunn and I. Bowling, Chapter 53 in *Conference Proceedings: Foundations of Computer Aided Process Design 2009: Design for Energy and the Environment*, Taylor & Francis, 2009, 579-584.
4. Failure Analysis of Polymer Products and Chemical Processes to Identify Design Deficiencies, R. F. Dunn and T. Mills III, Chapter 84 in *Conference Proceedings: Foundations of Computer Aided Process Design 2009: Design for Energy and the Environment*, Taylor & Francis, 2009, 871-878.
5. Minimization of Environmental Discharge Through Process Integration, G. Parthasarathy and R. F. Dunn, Chapter 11 in *Towards Zero Discharge: Innovative Methodology and Technologies for Process Pollution Prevention*, John Wiley & Sons, Inc., New Jersey, 2005, 597-645.
6. Challenges for Applying Process Integration Design Methodologies in the Chemical Process Industries, R. F. Dunn, Chapter 4 in *Process Design Tools for the Environment*, Taylor & Francis Publishers, New York, 2001, 105-120.
7. Process Integration of Material and Energy, R. Dunn-editor, in Energy and the Environment-Topical Conference Proceedings, *AICHE 2000 Annual Meeting*, Los Angeles, November 2000, 229-263.
8. Managing Environmental Risks, H. Cabezas and R. F. Dunn, editors, *AICHE 1999 Spring Annual Meeting Conference Proceedings*, Houston, March 1999, 61-82.
9. Process Integration for Pollution Prevention, 1999, R. F. Dunn and B. K. Srinivas, in *Emerging Separation and Separative Reaction Technologies for Process Waste Reduction: Adsorption and Membrane Systems*, published by the American Institute of Chemical Engineers, New York, 277-281.
10. Tutorials in Batch Process Design and Operations: *Design*, U. M. Diweker and R. F. Dunn, editors, *AICHE 1998 Spring Meeting Conference Proceedings*, New Orleans, March 1998, 3-46.
11. Tutorials in Batch Process Design and Operations: *Scale Up and Operations*, U. M. Diweker and R. F. Dunn, editors, *AICHE 1998 Spring Meeting Conference Proceedings*, New Orleans, March 1998, 49-80.
12. Tutorials in Batch Process Design and Operations: *Methods and Tools*, U. M. Diweker and R. F. Dunn, editors, *AICHE 1998 Spring Meeting Conference Proceedings*, New Orleans, March 1998, 83-133.
13. Design of Cost-Effective VOC Recovery Systems, 1996, R. F. Dunn and M. M. El-Halwagi, *Published by Tennessee Valley Authority Environmental Research Center/EPA Center for Waste Reduction*, <http://www.p2pays.org/ref/01/00034.html>, 82 pp.

### **Peer Reviewed Articles**

1. "Failure of plastic press release buttons in automobile seat belts," 2005, R. F. Dunn, R. H. McSwain, T. Mills and B. Malone, *Engineering Failure Analysis*, 12, 81-98.
2. "Graphical Strategies for Design of Evaporation Crystallization Networks for Environmental Wastewater Applications," 2003, G. Parthasarathy and R. F. Dunn, *Advances in Environmental Research*, 8, 247-265.
3. "Process Integration Technology Review: Background and Applications in the Chemical Process Industry," 2003, R. F. Dunn and M. M. El-Halwagi, *Journal of Chemical Technology and Biotechnology*, 78, p. 1011-1021.
4. "Energy Optimization of Pressure Swing Azeotropic Distillation Systems," 2002, A. Hamad and R. Dunn, *Industrial & Engineering Chemistry Research*, 41, 6082-6093.
5. "Process Integration Design Methods for Water Conservation and Wastewater Reduction in Industry, Part 3: Experience of Industrial Applications," 2001, H. Wenzel, R. F. Dunn, Lene Gottrop, Jon Kringselum, *Clean Technologies and Environmental Policy*, 4 (2002) 16-25.

6. "Process Integration Design Methods for Water Conservation and Wastewater Reduction in Industry, Part 1: Design for Single Contaminants," 2001, R. F. Dunn and H. Wenzel, *Clean Products and Processes*, 3, 307-318.
7. "Process Integration Design Methods for Water Conservation and Wastewater Reduction in Industry, Part 2: Design for Multiple Contaminants," 2001, R. F. Dunn, H. Wenzel, M. Overcash, *Clean Products and Processes*, 3, 319-329.
8. "Challenges for Applying Process Integration Design Methodologies within Chemical Process Companies," R. F. Dunn, Ch. 4 in *Process Design Tools for the Environment*, Taylor & Francis Publishers, New York, 2001, 105-120.
9. "Design of Heat-Integrated Evaporation and Crystallization Networks for Separation of Ternary Wastewater Systems, Part I: Design of the Separation System," 2001, G. Parthasarathy, R. F. Dunn, and M. M. El-Halwagi, *Industrial and Engineering Chemistry Research*, 40, 2827-2841.
10. "Design of Heat-Integrated Evaporation and Crystallization Networks for Separation of Ternary Wastewater Systems, Part II: Identification of the Interception Design Task," 2001, G. Parthasarathy, R. F. Dunn, and M. M. El-Halwagi, *Industrial and Engineering Chemistry Research*, 40, 2842-2856.
11. "A Process Integration Design Method for Water Conservation and Wastewater Reduction in Industry," R. F. Dunn and H. Wenzel, 2001, *11<sup>th</sup> European Symposium on Computer Aided Process Engineering (ESCAPE 2001) Conference Proceedings*.
12. "Using Process Integration Technology for CLEANER Production," 2001, Russell F. Dunn and Greg E. Bush, *Journal of Cleaner Production*, 9(1), 1-23.
13. "Synthesis of Energy-Induced Waste Minimization Networks (EIWAMINs) for Simultaneous Waste Reduction and Heat Integration," R. F. Dunn, A. A. Hamad and A. M. Dobson, *Clean Products and Processes*, 1(2), 1999, 91-106.
14. "Water Conservation & Reuse at a Major CPI Facility," R. F. Dunn and A. M. Dobson, National Association of Corrosion Engineering, Annual Conference Proceedings, 1999, paper 317, p. 1-18.
15. "Process Integration for Pollution Prevention," 1999, R. F. Dunn and B. K. Srinivas, *Emerging Separation and Separative Reaction Technologies for Process Waste Reduction: Adsorption and Membrane Systems*, published by the American Institute of Chemical Engineers, New York, 277-281.
16. "A Spreadsheet-Based Approach to Identify Cost-Effective Heat-Induced and Energy-Induced Separation Networks for Condensation-Hybrid Processes," 1998, R. F. Dunn and A. M. Dobson, *Advances in Environmental Research*, 2(3), 269-290.
17. "Systematic Synthesis of VOC Recovery Membrane-Condensation Hybrid Systems," 1998, E. W. Crabtree, R. F. Dunn, and M. M. El-Halwagi, *Journal of the Air and Waste Management Association*, 48, 616-626.
18. "Synthesis of Heat-Induced Waste Minimization Networks HIWAMINs," 1997, R. F. Dunn and B. K. Srinivas, *Advances in Environmental Research*, 1(3), 275-301.
19. "Optimal Design of Environmentally-Acceptable Solvent Blends for Coatings," 1997, R. F. Dunn, A. M. Dobson, and M. M. El-Halwagi, *Advances in Environmental Research*, 1(2), 115-134.
20. "Optimal Design of Energy-Induced Separation Networks for VOC Recovery," 1995, R. F. Dunn, B. K. Srinivas, M. Zhu, and M. M. El-Halwagi, *AICHE Journal, Symposium Series: Pollution Prevention via Process and Product Modifications*, Vol. 90, Number 103, p. 74-85.
21. "Synthesis of Optimal Heat-Induced Separation Networks," 1995, M. M. El-Halwagi, B. K. Srinivas, and R. F. Dunn, *Chemical Engineering Science*, 50(1), 81-97.
22. "Optimal Design of Multi-Component VOC Condensation Systems," 1994, R. F. Dunn and M. M. El-Halwagi, *Journal of Hazardous Materials*, 38, 187-206.
23. "Selection of Optimal VOC-Condensation Systems," 1994, R. F. Dunn and M. M. El-Halwagi, *Waste Management*, 14(2), 103-113.
24. "Optimal Recycle/Reuse Policies for Minimizing the Wastes of Pulp and Paper Plants," 1993, R. F. Dunn and M. M. El-Halwagi, *Journal of Environmental Science and Health*, A28(1), 217-234.

## **Non-Peer Reviewed Articles**

1. "Oxidation and Degradation of Polypropylene Transvaginal Mesh", Anne D. Talley, Bridget R. Rogers, Vladimir Iakovlev, Russell F. Dunn, and Scott A. Guelcher, IUGA 2015 Best Paper Submission, Nice France, April 2015.
2. "Considering Environmental and Safety Factors for Sustainable Design," R. F. Dunn, Topical Conference Proceedings, AIChE 2003 Annual Meeting, San Francisco, CA, Nov. 2003.
3. "Mass Integration Technology to Identify Cost-Effective Wastewater Minimization Strategies," R. F. Dunn, Topical Conference Proceedings, AIChE 2003 Annual Meeting, San Francisco, CA, Nov. 2003.

4. "US Industrial Experience on Process Integration," R. Dunn, Centre for Industrial Water Management Newsletter, Copenhagen, Denmark, 2001.
5. "Modelling, Design and Control for Process Integration" – Ph.D. Course Notes, R. F. Dunn, *The Technical University of Denmark*, Department of Chemical Engineering, Lyngby, Denmark, 1999.
6. "The Water Allocation Design and Engineering (WADE) Methodology for Wastewater Reduction in the Chemical Process Industries," R. F. Dunn, *Copenhagen Waste and Water Conference 1999 Proceedings*, Copenhagen, Denmark, June 1999.
7. "Design of Energy-Induced Waste Minimization Networks," A. M. Dobson, A. A. Hamad and R. F. Dunn, Process Systems Engineering Topical Conference Proceedings, AIChE 1999 Spring Meeting, Houston, TX, March 1999, 102-124.
8. "Application of Process Integration Technology in the Chemical Process Industry," R. F. Dunn, A. A. Hamad, A. M. Dobson, Process Systems Engineering Topical Conference Proceedings, AIChE 1999 Spring Meeting, Houston, TX, March 1999, 45-57.
9. "Maximizing the Full Potential of Chemical Process Design and Improvement via Improved Integration of Available Simulation and Optimization Tools," G. E. Bush, D. L. Davidson, R. F. Dunn, G. Tanaka, Process Systems Engineering Topical Conference Proceedings, AIChE 1999 Spring Meeting, Houston, TX, March 1999, 140-151.
10. "Synthesis of Mass and Energy Integrated Systems for the Source Reduction of Pollution," B.K. Srinivas and R. F. Dunn, Conference Proceedings, Process Integration Annual Meeting, Copenhagen, Denmark, April 1999.
11. Book Review: "Pollution Prevention Through Process Integration", R. F. Dunn, *Clean Products and Processes*, 1(1), 1998, 70.
12. "Selection of Organic Solvent Blends for Environmental Compliance in the Coating Industries," 1994, R. F. Dunn, M. M. El-Halwagi, J. Lakin, M. Seralgadin, *First International Plant Operations and Design Conference Proceedings*, Vol. 3 Plant Equipment and Design, p. 83-107.
13. "Selection of Optimal Separation Systems for Waste Minimization," 1992, R. F. Dunn, R. Vaidyanathan, A. E. Warren, and M. M. El-Halwagi, *First Separation Division Topical Conference on Separation Technologies*, AIChE, NY, 215-219.

## **INVITED PRESENTATIONS:**

1. "From Energy to Mass Integration: Industrial Experiences," R. F. Dunn, Process Integration Jubilee Conference 2013, Gothenburg, Sweden, March 2013.
2. "Senior Design Project Experiences using Process Integration," R. F. Dunn, Process Integration Jubilee Conference 2013, Gothenburg, Sweden, March 2013.
3. "Industrial Experience using Process Integration," R. F. Dunn, Singapore Refining Company, Singapore, November 2012.
4. "Industrial Experience using Process Integration," R. F. Dunn, Singapore Public Utility Board, Singapore, November 2012.
5. "Scientific Evidence Analysis: Using Chemical Engineering Experts," R. F. Dunn, Vanderbilt Law School, Nashville, TN, November 2011.
6. "Using Chemistry in Accident Investigations," R. F. Dunn, University of West Florida, Pensacola, FL, December 2009.
7. "Using Process Integration Technology for Energy and Water Conservation in Industry," R. F. Dunn, Aditya Birla Conference on Process Intensification and Re-engineering, Vadadora, India, October 2005.
8. "Using Process Integration Technology for Energy and Water Conservation in Industry," R. F. Dunn, Birla Copper Industrial Site, Dahej, India, October 2005.
9. "Using Process Integration Technology for Energy and Water Conservation in Industry," R. F. Dunn, Aditya Birla Corporate Headquarters, Mumbai, India, October 2005.
10. "Using Chemistry in Accident Investigations," R. F. Dunn, University of West Florida, Pensacola, FL, March 2005.
11. "Tutorial on Process Integration," R. F. Dunn, American Institute of Chemical Engineers 2004 Spring Meeting, New Orleans, LA, April 2004.
12. "Process Integration Design Tools for Water Conservation and Wastewater Reduction," R. F. Dunn, Water Environment Federation's 8<sup>th</sup> Annual Industrial Wastes Technical and Regulatory Conference, Atlantic City, NJ, August 2002.

13. "Industrial Examples of Process and Product Design," R. F. Dunn, Chemical Engineering Graduate Seminar Series, Louisiana State University, October 2001.
14. "The Expanding Role of Chemical Engineering in the Investigation of Accidents and Environmental Forensics," R. F. Dunn, Chemical Engineering Graduate Seminar Series, Auburn University, October 2001.
15. "Save Energy and Water through Process Integration," R. F. Dunn and H. Wenzel, Aalborg University, Esbjerg, Denmark, August 2000.
16. "Examples of Process Integration Design in Danish Industries," H. Wenzel and R. F. Dunn, Aalborg University, Esbjerg, Denmark, August 2000.
17. "Using Process Integration Technology for CLEANER Production," R. F. Dunn, Rohm and Haas Technical Center, Bristol, PA, July 2000.
18. "Designing Cleaner Plastics," G. E. Bush, R. Dunn and S. W. Cook, United Engineering Foundation Conference on Clean Products and Processes-II, Lake Arrowhead, CA, November 1999.
19. "A Systematic Design Strategy for Water Management and Wastewater Reduction," R. F. Dunn, A. M. Dobson and G. E. Bush, AIChE Center for Waste Reduction Technologies (CWRT)-Water Management Workshop, St. Louis, MO, November 1999.
20. "Industrial Applications of a Systematic Design Strategy for Water Management and Wastewater Reduction Within Solutia," R. F. Dunn, AIChE Center for Waste Reduction Technologies (CWRT)-Water Management Workshop, St. Louis, MO, November 1999.
21. "A Career Path in Chemical Engineering: Process and Product Development," R. F. Dunn, Auburn University, Auburn, Alabama, October 1999.
22. "The Water Allocation Design and Engineering (WADE) Methodology for Wastewater Reduction in the Chemical Process Industries," R. F. Dunn, Copenhagen Waste and Water Conference 1999, Copenhagen, Denmark, June 1999.
23. "Process Integration Technology for Clean Processes," R. F. Dunn, NATO Conference on Clean Products and Processes, Belfast, Northern Ireland, March, 1999.
24. "Synthesis of Mass and Energy Integrated Systems for the Source Reduction of Pollution," B.K. Srinivas and R. F. Dunn, Process Integration Annual Meeting, Copenhagen, Denmark, April 1999.
25. "Water Conservation & Reuse at a Major CPI Facility," A. M. Dobson and R. F. Dunn, National Association of Corrosion Engineering (NACE) Annual Meeting, San Antonio, TX, April 1999.
26. "Process Integration for Pollution Prevention," R. F. Dunn and B. K. Srinivas, AIChE Center for Waste Reduction Technologies (CWRT)-Separations Technology Workshop, New Orleans, LA, February 1998.
27. "Process Integration, Part I: Technology Overview," R. F. Dunn, Science Applications International Corporation, Reston, VA, October 1997.
28. "Process Integration, Part II: Industrial Applications," R. F. Dunn, Science Applications International Corporation, Reston, VA, October 1997.
29. "Design Tools for Identifying Optimal Waste Minimization Systems," R. F. Dunn, Engineering Foundation Conference: Clean Products and Processes, San Diego, CA, June 1997.
30. "Synthesis of Heat-Induced Waste Minimization Networks HIWAMINs," R. F. Dunn, Owens-Corning Corporation-Science and Technology Center, Granville, OH, April 1997.
31. "Design of Energy-Efficient, Cost-Effective VOC Recovery Systems," R. F. Dunn and M. M. El-Halwagi, Tennessee Valley Authority Environmental Research Center, Muscle Shoals, AL, June 1995.

## **PRESENTATIONS:**

1. "Safety Immersion Education using Vanderbilt's Chemical Process Innovation Center", Russell F. Dunn and Scott A. Guelcher, American Institute of Chemical Engineers 2015 Annual Meeting, Salt Lake City, UT, November 2015.
2. "Using Vanderbilt's Chemical Process Innovation Center for Immersive Chemical Engineering Design and Laboratory Courses", Russell F. Dunn and Scott A. Guelcher, American Institute of Chemical Engineers 2015 Annual Meeting, Salt Lake City, UT, November 2015.
3. "Oxidation and Degradation of Polypropylene Transvaginal Mesh", Scott A. Guelcher, Vladimir Iakovlev, and Russell F. Dunn, IUGA 2015 Annual Conference, Nice France, April 2015.
4. "Failure Analysis of Transvaginal Mesh Products – a Biomaterials Perspective Using Materials Science Fundamentals", R. F. Dunn, S. A. Guelcher and V. Iakovlev, American Institute of Chemical Engineers 2014 Annual Meeting, Atlanta, GA, November 2014.
5. "Incorporating Measurement Lab Design Projects in an Undergraduate Chemical Engineering Laboratory

- Course", R. F. Dunn and M. Lang, American Institute of Chemical Engineers 2014 Annual Meeting, Atlanta, GA, November 2014.
6. "Water Recycle and Reuse Software Design", R. F. Dunn, K. Debelak and J. Ristau, American Institute of Chemical Engineers 2014 Annual Meeting, Atlanta, GA, November 2014.
  7. "Use of a Commercial-Scale Reverse Osmosis Laboratory Module to Illustrate Interception Technology Applications in Water Pinch Network Design", R. F. Dunn and J. Ristau, American Institute of Chemical Engineers 2014 Annual Meeting, Atlanta, GA, November 2014.
  8. "Starting an Small Engineering Consulting Business – the 10 Year Anniversary of a Startup Company", R. F. Dunn, American Institute of Chemical Engineers 2014 Annual Meeting, Atlanta, GA, November 2014.
  9. "Incorporating Process Integration Methodologies into Senior Capstone Design Courses", R. F. Dunn and K. Debelak, American Institute of Chemical Engineers 2013 Annual Meeting, San Francisco, CA, November 2013.
  10. "A Shortcut Graphical and Spreadsheet Technique for Identifying Water Allocation Networks", R. F. Dunn, K. Debelak and Z. Perlmutter, American Institute of Chemical Engineers 2013 Annual Meeting, San Francisco, CA, November 2013.
  11. "Teaching Safety in Undergraduate Chemical Engineering Laboratory and Chemical Engineering Design Courses", R. F. Dunn and K. Debelak, American Institute of Chemical Engineers 2013 Annual Meeting, San Francisco, CA, November 2013.
  12. "A Shortcut Graphical and Spreadsheet Technique for Identifying Heat Exchange Networks", R. F. Dunn and K. Debelak, American Institute of Chemical Engineers 2012 Annual Meeting, Pittsburgh, PA, November 2012.
  13. "A Shortcut Graphical and Spreadsheet Technique for Identifying Mass Exchange Networks", R. F. Dunn and K. Debelak, American Institute of Chemical Engineers 2012 Annual Meeting, Pittsburgh, PA, November 2012.
  14. "Analyzing Complex Chemical and Polymer Manufacturing Plants: A Macroscopic Approach", R. F. Dunn and I. Bowling, Chapter 53 in Conference Proceedings: Foundations of Computer Aided Process Design 2009: Design for Energy and the Environment, Breckinridge, CO, 2009.
  15. "Failure Analysis of Polymer Products and Chemical Processes to Identify Design Deficiencies", R. F. Dunn and T. Mills III, Chapter 84 in Conference Proceedings: Foundations of Computer Aided Process Design 2009: Design for Energy and the Environment, Breckinridge, CO, 2009.
  16. "Considering Environmental and Safety Factors for Sustainable Design", R. F. Dunn, American Institute of Chemical Engineers 2003 Annual Meeting, San Francisco, CA, November 2003.
  17. "Mass Integration Technology to Identify Cost-Effective Wastewater Minimization Strategies", R. F. Dunn, American Institute of Chemical Engineers 2003 Annual Meeting, San Francisco, CA, November 2003.
  18. "Simulation-Aided Energy Optimization of Azeotropic Systems," A. Hamad and R. F. Dunn, American Institute of Chemical Engineers 2002 Annual Meeting, Indianapolis, IN, November 2003.
  19. "Process Integration Design Methods for Water Conservation and Wastewater Reduction in Industry," R. F. Dunn, H. Wenzel and M. Overcash, American Institute of Chemical Engineers 2002 Annual Meeting, Indianapolis, IN, November 2002.
  20. "Use of Life Cycle Analysis to Modify Traditional Pinch Optimization, Mass and Energy Integration," G. Parthasarathy, M. Overcash and R. F. Dunn, American Institute of Chemical Engineers 2002 Annual Meeting, Indianapolis, IN, November 2002.
  21. "Graphical Strategies for Design of Evaporation Crystallization Networks for Environmental Wastewater Applications," R. F. Dunn and G. Parthasarathy, American Institute of Chemical Engineers 2002 Annual Meeting, Indianapolis, IN, November 2002.
  22. "Process Integration Design Methods for Water Conservation and Wastewater Reduction for Streams Containing Single Contaminants," R. F. Dunn and H. Wenzel, American Institute of Chemical Engineers 2001 Annual Meeting Conference, Reno, NV, November 2001.
  23. "Process Integration Design Methods for Water Conservation and Wastewater Reduction for Streams Containing Multiple Contaminants," R. F. Dunn, H. Wenzel, and M. Overcash, American Institute of Chemical Engineers 2001 Annual Meeting Conference, Reno, NV, November 2001.
  24. "Interception Task Identification of Evaporation and Crystallization Networks for Ternary Wastewater Streams," G. Parthasarathy, R. F. Dunn, and M. M. El-Halwagi, American Institute of Chemical Engineers 2001 Annual Meeting Conference, Reno, NV, November 2001.
  25. "Design and Synthesis of Evaporation and Crystallization Systems for Ternary Wastewater Streams," G. Parthasarathy, R. F. Dunn, and M. M. El-Halwagi, American Institute of Chemical Engineers 2001 Annual Meeting Conference, Reno, NV, November 2001.
  26. "Tools for Data Extraction, Modeling, Simulation and Analysis of the Nylon 6,6 Continuous Polymerization Process," G. Parthasarathy, R. F. Dunn, and G. E. Bush, American Institute of Chemical Engineers 2001 Annual Meeting Conference, Reno, NV, November 2001.

27. "A Process Integration Design Method for Water Conservation and Wastewater Reduction in Industry," Russell F. Dunn and Henrik Wenzel, 11<sup>th</sup> European Symposium on Computer Aided Process Engineering (ESCAPE 2001) Conference, Copenhagen, Denmark, May 2000.
28. "Challenges for Applying Process Integration Technologies for Waste Reduction Within Chemical Process Companies," R. F. Dunn, AIChE 2000 Spring Annual Meeting, Atlanta, GA, March 2000.
29. "Using Process Integration Technology for CLEANER Production," R. F. Dunn and G. E. Bush, AIChE 2000 Spring Annual Meeting, Atlanta, GA, March 2000.
30. "Maximizing the Full Potential of Chemical Process Design and Improvement via Improved Integration of Available Simulation and Optimization Tools," G. E. Bush, D. L. Davidson, R. F. Dunn, AIChE 1999 Spring Meeting, Houston, TX, March 1999.
31. "Design of Energy-Induced Waste Minimization Networks," R. F. Dunn, A. M. Dobson, and A. A. Hamad, AIChE 1999 Spring Meeting, Houston, TX, March 1999.
32. "A Process Design Strategy for Simultaneous Waste Minimization and Energy Conservation," R. F. Dunn, A. M. Dobson, and A. A. Hamad, AIChE 1999 Spring Meeting, Houston, TX, March 1999.
33. "Application of Process Integration Technology in the Chemical Process Industry," R. F. Dunn, A. M. Dobson, and A. A. Hamad, AIChE 1999 Spring Meeting, Houston, TX, March 1999.
34. "Systems-Based Design Tools for Pollution Prevention," R. F. Dunn, AIChE 1998 Spring Meeting, New Orleans, LA, March 1998.
35. "Synthesis of Heat-Induced Waste Minimization Networks," R. F. Dunn, AIChE 1997 Spring Meeting, Houston, TX, March 1997.
36. "Optimal Design of Treatment Systems for Waste Minimization," A. M. Dobson and R. F. Dunn, AIChE 1997 Spring Meeting, Houston, TX, March 1997.
37. "Synthesis and Optimization for Environmental Process Design-A Review of the State of the Art," R. F. Dunn, M. M. El-Halwagi, and B. K. Srinivas, AIChE 1997 Spring Meeting, Houston, TX, March 1997.
38. "Synthesis of Mass and Energy Integration Networks for Waste Minimization via In-Plant Modifications," R. F. Dunn, A. M. Dobson, T. Heely, and B. K. Srinivas, AIChE 1997 Spring Meeting, Houston, TX, March 1997.
39. "Simultaneous Synthesis of Separating Agents and Separation Networks for Removal of VOC's from Air," A. Hamad, M. M. El-Halwagi and R. F. Dunn, AIChE 1996 Annual Meeting, Chicago, IL, November 1996.
40. "Industrial Applications of Process Synthesis in the Polymer Manufacturing Industry," B.K. Srinivas and R. F. Dunn, AIChE 1996 Annual Meeting, Chicago, IL, November 1996.
41. "A Process Integration Approach to Incorporating Environmental Issues into Process Design," R. F. Dunn, M. M. El-Halwagi, H. D. Spriggs, and B. K. Srinivas, Institute for Operations Research and the Management Sciences Annual Meeting, Atlanta, GA, November 1996.
42. "Optimal Design of Flexible VOC-Separation Membrane Systems," M. Zhu, E. Crabtree, R. F. Dunn, and M. M. El-Halwagi, AIChE Meeting, Miami, FL, November 1995.
43. "Synthesis of Membrane/Condensation Hybrid Systems for VOC Recovery," E. W. Crabtree, R. F. Dunn and M. M. El-Halwagi, North America Membrane Society 1995 Conference, Portland, OR, May 1995.
44. "Selection of Organic Solvent Blends for Environmental Compliance in the Coating Industries," R. F. Dunn, M. M. El-Halwagi, J. Lakin, M. Seralgadin and R. Vaidyanathan, AIChE 1995 Spring Meeting, Houston, TX, April 1995.
45. "Optimal Design of Multi-Component VOC-Condensation Systems," R. F. Dunn and M. M. El-Halwagi, AIChE 1994 Annual Meeting, San Francisco, CA, November 1994.
46. "Synthesis of Optimal Heat-Induced Separation Networks for VOC-Recovery," M. M. El-Halwagi, B. K. Srinivas, and R. F. Dunn, AIChE 1994 Spring Meeting, Atlanta, GA, April 1994.
47. "Optimal Design of Hybrid VOC Recovery Systems for Gaseous Emissions," R. F. Dunn and M. M. El-Halwagi, AIChE 1994 Spring Meeting, Atlanta, GA, April 1994.
48. "Optimal Design of Heat-Induced Separation Networks," B. K. Srinivas, R. F. Dunn, M. M. El-Halwagi, AIChE 1993 Annual Meeting, St. Louis, MO, November 1993.
49. "Synthesis of Optimal VOC-Condensation Systems," R. F. Dunn and M. M. El-Halwagi, AIChE 1993 Summer Meeting, Seattle, WA, August 1993.
50. "Integration of Separation Technologies for the Removal of VOC's from Dilute Aqueous Streams," R. F. Dunn and M. M. El-Halwagi, AIChE 1993 Summer Meeting, Seattle, WA, August 1993.
51. "Selection of Optimal Separation Systems for Recovering VOC Emissions," R. F. Dunn, R. Vaidyanathan, A. Warren, and M. M. El-Halwagi, AIChE 1992 Annual Meeting, Miami, FL, October 1992.
52. "Design of Reactive Mass-Exchange Networks," B.K. Srinivas, M. M. El-Halwagi, and R. F. Dunn, AIChE 1992 Annual Meeting, Miami, FL, October 1992.

53. "Design of Integrated Waste Management Networks," R. F. Dunn and M. M. El-Halwagi, ACS Symposium on Emerging Hazardous Waste Technologies, Atlanta, GA, September 1992.
54. "Optimal Recycle/Reuse Policies for Minimizing the Wastes of Pulp and Paper Plants," R. F. Dunn and M. M. El-Halwagi, ACS Symposium on Emerging Hazardous Waste Technologies, Atlanta, GA, October 1991.

**ACADEMIC COURSES TAUGHT:**

**At Vanderbilt University:**

- Chemical Engineering Product and Process Design
- Chemical Engineering Senior Design Projects
- Chemical Engineering Senior Design Seminar
- Chemical Engineering Unit Operations Laboratory I
- Chemical Engineering Unit Operations Laboratory II
- Independent Study

**At Auburn University:**

- Chemical Engineering Material Balances
- Chemical Engineering Energy Balances
- Chemical Engineering Unit Operations Laboratory I (w/ Statistical Process Control)
- Chemical Engineering Unit Operations Laboratory II (w/ Statistical Process Control)
- Reaction Engineering Laboratory
- Undergraduate Research

**At the Technical University of Denmark:**

- Modeling, Design and Control for Process Integration (PhD Course)

**At the University of West Florida:**

- Chemistry II Lab
- Fundamentals of General Chemistry
- Fundamentals of General Chemistry Lab

## **CONTINUING ENGINEERING EDUCATION:**

<b><u>Course Title</u></b>	<b><u>Source</u></b>	<b><u>Date</u></b>
Safety Education and Practice in the Academic Environment	American Institute of Chemical Engineers, Atlanta, GA	2014
Incident Investigation	American Institute of Chemical Engineers, Orlando, FL	2006
Trace DSQ (Gas Chromatography/Mass Spectrometry) Training Course	Thermo Electron Institute, West Palm Beach, FL	2003
Failure Mode and Effects Analysis	Quality Associates International	2003
Fourier Transform Infrared Spectroscopy - Continuum Microscope	Thermo Electron	2003
Fourier Transform Infrared Spectroscopy - Spectral Interpretation	Thermo Nicolet	2002
Linear Elastic Fracture Mechanics	Metallurgical Research	2001
Plastics Fracture Analysis Workshop	Society of Plastics Engineers, Chicago, IL	2001
Plastics Failure Analysis, Prevention and Testing	Society of Plastics Engineers, Chicago, IL	2001
Failure Analysis of Plastics Through Stress Analysis Methods	Society of Plastics Engineers, Chicago, IL	2001
Nylon 6,6 Plastics and Polymers: Chemistry and Process Fundamentals	Solutia, Pensacola, FL	2001
Polymer Properties: Relation to Polymer Structure and Processing	American Institute of Chemical Engineers, New Orleans, LA	1998
Engineering Mini-Courses	Solutia, Pensacola, FL	1997
Nylon 6,6: Fundamentals and Processes	Solutia, Pensacola, FL	1996
Introduction to Polymer Science	Solutia, Pensacola, FL	1996
The Kerzner Approach to Project Management	The Project Management Institute and GE Plastics, Mt. Vernon, IN	1995
Design of Experiments via the Taguchi Methods	Ampex Corporation, Opelika, AL	1988
Statistical Process Control	Ampex Corporation, Opelika, AL	1986